

CARNIVOROUS PLANT NEWSLETTER

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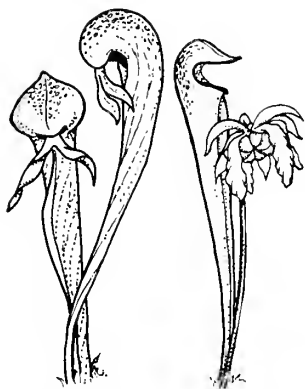
December 2007



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Front Cover: *Pinguicula balcanica* growing in a streamside site, Pirin Mountain, Bulgaria. Article on page 100. Photograph by Lorenzo Peruzzi.

Back Cover: A remarkable discovery of *G. pygmaea* with tubers. See article on page 122. Photograph by Fernando Rivadavia.

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SOME OBSERVATIONS ON *PINGUICULA BALCANICA* CASPER AND
P. HIRTIFLORA TEN. (LENTIBULARIACEAE) FROM BALKANS

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Keywords: Observations: Bulgaria, Greece, *Pinguicula balcanica*, *Pinguicula hirtiflora*.

During field trips in June 2006 through Greece to Bulgaria, while going to the IV IBBC (International Balkan Botanical Congress) held in Sofia, I visited three Balkan butterwort localities, two with *Pinguicula balcanica* Casper and one with *P. hirtiflora* Ten. I give here a brief account of these findings.

Pinguicula balcanica Casper

The name *P. balcanica* was described by Casper (1962) for the plants formerly called “*P. vulgaris*” or “*P. leptoceras*” by earlier Balkan botanists; the holotype of this species was collected in NW Albania. *Pinguicula balcanica* belongs to *P. sect. Pinguicula* (Casper 1966) and is marked by temperate growth-type (with hibernacula production), blue flowers with white dot(s) on the lower lip (mostly on lower lip’s median lobe: “*lobo intermedio lateralibus majore basi albido-maculato*”) and not well opened corollas (45-90° opening angle). A particular feature of this species is the partial (or even total!) overlap of the two upper corolla lip lobes (“*labium superum bilobum lobis late-ligulatis inter se tegetibus*”), while the three lobes of the lower lip are close but not overlapping (see Figures 1, 2). This species was collected in the following two localities:

- a) Bulgaria, Vitosha Mountain (near Sofia), ca. 1,700-1,800 m a.s.l., 23 Jun 2006, L. Peruzzi (PI).
- b) Bulgaria, Pirin Mountain, ca. 2,000 m a.s.l., 26 Jun 2006, L. Peruzzi, D. Uzunov, G. Caruso (PI).

In both localities the species occurred commonly in marshes, bogs and along streams (see Front Cover) on siliceous substrate. Specimens from the two localities were measured and compared with the full description given by Casper (1966) for this species (see Table 1). Some characters, which were proved to be useful taxonomic markers in *sect. Pinguicula* (Conti & Peruzzi 2006) were detected for the first time in this species, such as the dimensions of the calyx lips and of each type of corolla lobe (upper, lateral, median). All these features indeed confirm the intermediate character of this species

	Casper (1966)	Vitosha, Bulgaria	Pirin, Bulgaria
# of leaves/plant	5-9	6-8	4-8
Leaf size	20-50 × 10-20 mm	30-50 × 15-20 mm	30-50 × 14-16 mm
# of peduncles/plant	1-5	1	1-3
Peduncle length	(20)40-80(100) mm	100-130 mm	35-120 mm
Flower length (with spur)	(8)14-19(23) mm	20-25(27) mm	16-22 mm
Spur length	—	6-7 mm	5-6 mm
Calyx upper lip	—	1.5 × 2 mm	1 × 1.5 mm
Calyx lower lip	—	2 × 1.5 mm	2 × 1.5 mm
Corolla upper lip lobes	—	4-5 × 3.5-4.5 mm	4-4.5 × 3 mm
Corolla lower, lateral lip lobes	—	4.5-6 × 6-6.5 mm	3.5-5 × 3.5-4.5 mm
Corolla lower, median lip lobe	—	6.5-8 × 8-9 mm	4.5-5.5 × 3.5-5 mm

Table 1: Comparisons for *P. balcanica* among the quantitative data given by Casper (1966) and the two Bulgarian populations. In combined measurements, the first one is the length and the second one is the width.



Figure 1: *Pinguicula balcanica* (Bulgaria, Vitosha Mountain), close-up of a flower.



Figure 2: *Pinguicula balcanica* (Bulgaria, Vitosha Mountain), close-up of a flower.



Figure 3: Basal rosette of *P. balcanica*, showing roots and several gemmae-like structures (arrows) in Bulgaria, Vitosha Mountain.



Figure 4: *Pinguicula hirtiflora* (Greece, N Pindhos) in flower.



Figure 5: Hundreds of *P. hirtiflora* rosettes (Greece, N Pindhos) in flower.

between *P. vulgaris* L. *sensu lato* and *P. leptoceras* Rchb. *Pinguicula balcanica* is known in literature as heterophyllous (Casper 1966; Legendre 2000). We found no evidence for clear heterophylly in this species, as instead clearly occurs in other representatives of sect. *Pinguicula* (such as *P. longifolia* Ram. ex DC. *sensu lato*, *P. mundi* G. Blanca, M. Jamilena, M. Ruiz-Rejón & R. Zamora, *P. reichenbachiana* Schindler, *P. vallisneriifolia* Webb). According to our field observations, *P. balcanica* seems to be better classified as a homophyllous species. This matter—confirmed also by the examination of the pictures of Albanian material recently published by Casper (2006a)—suggests *P. balcanica* is even more closely related to *P. leptoceras*/*P. vulgaris* (both homophyllous species), even if it shows several unique combinations of character-states, as shown above. On the other hand, we also observed in this species the possible production of gemmae-like structures, which likely serve in the vegetative propagation of the individuals (see Figure 3). As far we are aware, this occurrence was never before evidenced in *P. balcanica* or similar species.

Pinguicula hirtiflora Ten.

After Strid (in Strid & Tan 1991), *P. hirtiflora* Ten. was considered for several years as a subspecies of *P. crystallina* Sibth. & Sm.; but seed anatomy features are significantly different in these two units (Degtjareva *et al.* 2004), supporting the reevaluation of two distinct species, despite their evident macro-morphological affinity. The name *P. hirtiflora*, first published by Tenore (1811), had a singular story, and was applied by its author—in different periods—to at least two different species (Peruzzi 2006; Casper 2006b). However, according to the typification made by Peruzzi *et al.* (2004), this name presently applies to a NE Mediterranean species belonging to sect. *Cardiophyllum*. This species is marked by tropical growth-type, homophylly, rose flowers more or less gradually fading to white and then bright yellow towards the corolla throat, corollas widely opened (120–180° opening angle), with all lobes divergent from each other and each of them more or less bilobed (see Figure 4). This species was collected in the following locality:

c) Greece, N Pindhos, along the road from Grevena to Metsovo, stillicidious scree, ca. 1,000 m a.s.l., 27 Jun 2006. L. Peruzzi, D. Uzunov, G. Caruso (PI).

In this locality *P. hirtiflora* occurs on a wet and slippery limestone scree along a road, with an incredibly high number of clustered individuals (see Figure 5). Morphological study of the individuals of this population indicated a close affinity with plants from the *locus classicus* in Campania, S Italy (measurements of these are reported in Peruzzi *et al.* 2004), but the Greek plants have a whiter corolla colouration-pattern. Populations from Albania (Casper 2006a) appear instead more similar in colouration-pattern to the Italian ones.

No access or collection permits were required to conduct these studies.

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PINGUICULA VULGARIS L. IN THE CHAMPAGNE STATE OF FRANCE:
LIFE IN AN ALKALINE BOG

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Keywords: field studies: France, *Pinguicula vulgaris*.

Abstract

Pinguicula vulgaris was observed growing in the Champagne state of France near the city of Rheims during 1994-2000. The plants are the remnants of what was, up to the beginning of the 20th century, a largely distributed set of populations that grew all over the Champagne and Paris basins. During the time of the study, the three populations were living in alkaline bogs and were gradually reducing in size. The plants differed from most other *P. vulgaris* by their ability to generate large numbers of gemmae in the winter, the round shape of their seed capsules and the small size of their leaf rosettes. A rough description of their habitat is presented in this article to explain their survival and observed dwindling numbers.

Introduction

Pinguicula vulgaris L. has the largest distribution of all *Pinguicula* species. This range covers Greenland, Iceland, most of the northern half of Northern America and a large part of Western Europe from the far north, southwards to the Oural mountains and the Mediterranean sea (Figure 1). *Pinguicula vulgaris* thrives at elevations from sea level up to 2,200 m altitude (Casper 1966). This large geographical and elevational distribution contrasts with those of most other *Pinguicula* species that are generally found at few small isolated locations. The impressive adaptability is paralleled by a large variation in morphological traits (Casper 1966). Since the original description of *P. vulgaris* by Linneus in 1753, many subspecies, forms and varieties have been described. Casper (1966) lists 24 different taxa at subspecific or lower rank. However, comprehensive biometric measurements and comparative studies that could support infra-specific

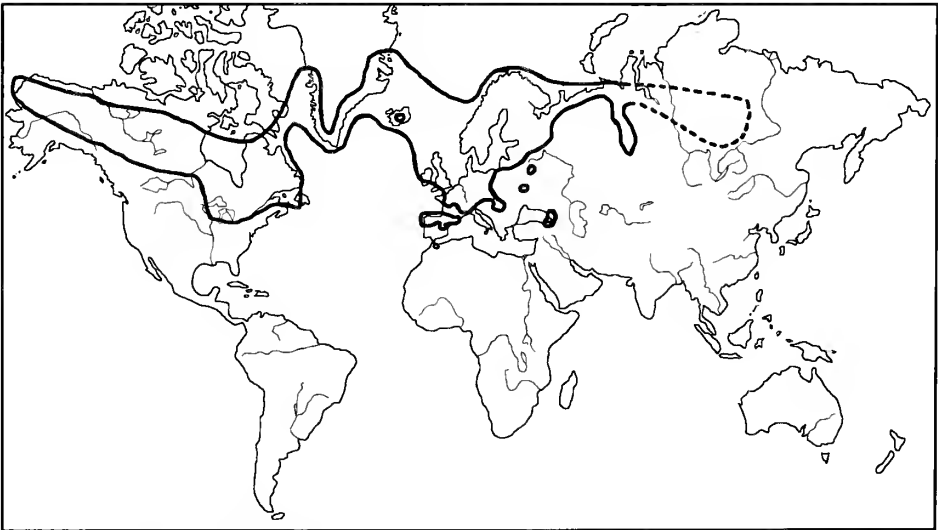


Figure 1: World distribution of *P. vulgaris*.

splits are missing so that only two flower color variants (*P. vulgaris* f. *bicolor* (Nordst. Ex Fries) Neumann and *P. vulgaris* f. *albida* (Behm) Neumann) were retained by Casper (1966) in his monographic revision of the genus. Steiger (1998) later described *P. vulgaris* var. *transsylvanica* Krajina, a variety with wider, often slightly overlapping corolla lobes and deeper separation of the lower calyx lobes. *Pinguicula vulgaris* grows in diverse biotopes. These include calcareous cliffs, acidic substrates (for example, a substratum pH of 4.9 has been determined for Greenland populations; Casper 1966) and gypsum-based substrates at pH values ranging from 5.7 to 8.2 for a west-pyrenean (southern France) population (Casper 1966).

Pinguicula vulgaris was observed 1994-2000 growing at three distinct sites in the Champagne state of France, all near the city of Rheims (Reims in French), 150 km east of the capital city, Paris. We could not confirm its presence on other sites previously described in this state. These three sites are less than 20 km apart and currently host 10, 100, and 2,000 plants. Even though these sites are at the center of the world distribution of *P. vulgaris*, the plants are isolated from their peers, the nearest populations of *P. vulgaris* being found more than 350 km away in the Netherlands, the Indre et Loire state of France or in distant mountain massifs of France, vosges, jura, alps or central massif (Dupont 1990). In the Champagne state of France, the plants are growing in a rarely described habitat, the alkaline bog. This article aims to relate some observations made on these plants and their biotope.

Materials and Methods

Seeds from the three populations (Chenay, Neuf-ans, Berru) growing in the Champagne state near the city of Rheims were collected in 1994 and 1995. Seeds of *P. vulgaris* were also collected over this same period from populations in the French vosges (Lac des truites), jura (City of Joux) and alps (Mont Joly). The exact provenances of the seeds of the Icelandic and Slovenian plants used in this study are unknown. Mature plants of *P. vulgaris* from Michigan (USA) were a gift of Pr. J.F. Steiger.

All seeds were germinated and grown at the center of the city of Rheims, in the same container (65×18×22 cm³) placed on a windowsill facing north-west. The community tank was equipped with a drainage hole 4 cm below the soil surface. Watering was done by the rain or, if this was insufficient to keep the water level up to the one of the drainage hole, tap water was added. The potting mix contained peat moss (5 parts), coarse sand (2 parts), local ground chalk (1 part), oak leaf litter (1 part) and oasis foam (1 cm³ cubes; 1 part). The potting mix was renewed once every other year early in the spring. Plants were grown and analyzed from 1994 till 2000.

Whole anthers were detached from mature flowers with tweezers and fixed by immersion in 5% glutaraldehyde followed by 2% osmium tetroxide. Fixed anthers were then critical point dried and glued on a scanning electron microscopy stub with high vacuum wax. The samples were sputter coated with platinum and viewed on an Hitachi S-800 SEM. Pollen grains present at the anther dehiscence hole were photographed. Their exudates were not washed prior to analysis. Mature, freshly harvested seeds were treated in a similar fashion.

Results

The flowers of the *P. vulgaris* plants of the three Champagne populations were similar in shape (Figure 2; Table 1) and differed slightly in color by being more pinkish-purple westward and more bluish-purple eastward. Their shape and color were consistent and within the range of variation currently accepted for *P. vulgaris*. Mature rosettes produced 1 or 2 flowers per season in the wild and when grown in Rheims, unlike the non-Champagne specimens in our study which produced an average of 4 to 10 flowers per season (Table 1). However, specimens in other cultural conditions in a western suburb of Paris have produced up to five flowers per season (E. Partrat, personal communication).

The rosettes of mature plants from the three studied Champagne populations were found to exhibit no significant difference in size in habitat and under cultivation. The Champagne plants



Figure 2: Morphology of the rosettes and flowers of *P. vulgaris* from Champagne state. Top two rows, plants in habitat; bottom row of flowers from cultivated specimens, flowers arranged according to Steiger (1978). Scale bar in centimeters. Photographs by Laurent Legendre.

were, however, smaller than the ones of all the non-Champagne specimens (Student's t-test, $p<0.01$ less than 1%) except the smallest non-Champagne populations (Iceland, Slovenia; $0.2<p<0.3$). As far as we know, the *P. vulgaris* plants from Iceland and Slovenia are the smallest in the species.

Calyx and corolla sizes were found to be comparable among all of the *P. vulgaris* plants in the study (Table 1). Lower calyx lobes were fused together for two thirds of their length for all the plants studied. Hibernacula were also similar in size and shape. The outer bud scales covered the entire bud and the buds did not bury themselves under the ground. Each year, the buds of the Champagne plants generated very large quantities of daughter buds (20-28 per mother bud on average) in contrast to all of the other *P. vulgaris* specimens which only produced a maximum of 1 daughter bud per year and most often none (Table 1). Mature seed capsules of the Champagne plants were perfectly round while the ones of the non-Champagne plants were pear-shaped (Table 1; Figure 3).

During our growing experiments, the plants of the Champagne state were the last to break dormancy in the spring, and the last to go to rest in the fall. Their winter buds broke dormancy at least three weeks after the others so they were generating their first leaves when plants from the other sites were already flowering. They did not return to dormancy during the hot summer months like the other *P. vulgaris* specimens, which did so by the end of August. In contrast, they continued producing new leaves all the way through the end of October. More leaves were produced in the fall than in the spring so that seedlings of the Champagne plants often yielded blooming plants one year after being sown, unlike those of the non-Champagne plants which required 2-3 years to bloom. While conducting a similar growth trial on the western side of Paris, E. Partrat was unable to confirm the observed retardation in bud sprouting in the spring (personal communication).

All of the specimens living close to Rheims produced very large quantities of seeds (about 50 per seed capsule), out of which more than 95% were viable. Two years in a row, *P. mundi* flowers were pollinated with the pollen of either an Iceland or a Rheims *P. vulgaris* population (5 crosses per parent combination). The first cross always yielded about 80 seeds per capsule

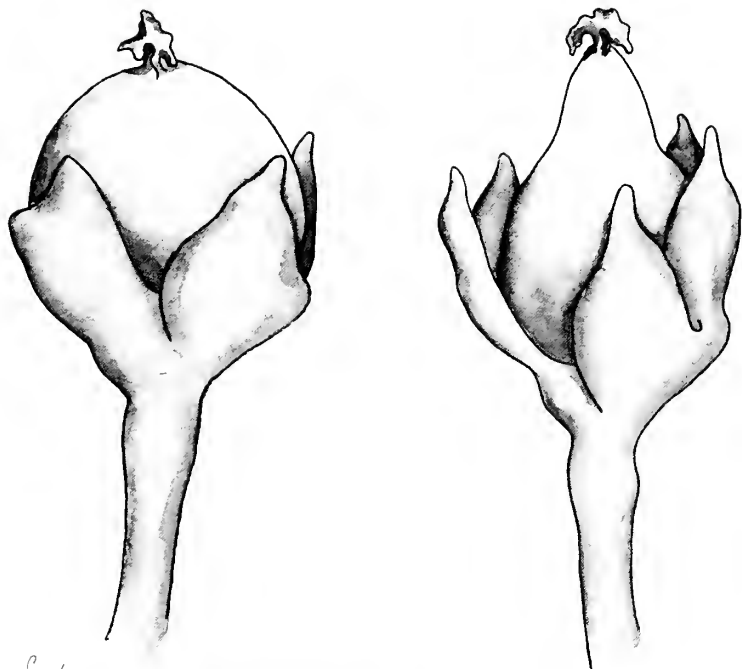
Location	Rosette diameter (cm)	Flowers per year ^a	Gemmae per year ^a	Capsule shape	Calyx diamter (mm)	Corolla width (mm)	Corolla length (mm)
Chenay ^b	5.2±0.7	2	20	Round	5.6±0.7	10±1.9	16±1.6
Neuf-ans ^b	5.3±1.7	2	22	Round	6.1±0.9	11±1.4	16±1.5
Berru ^b	6.3±1.6	2	28	Round	6.6±0.7	14±1.5	17±0.6
USA (Michigan) ^c	9.3±2.1	6	0	Pear-shaped	6.6±0.8	15±1.3	18±1.0
Iceland ^c	7.2±1.9	4	0	Pear-shaped	6.1±0.7	11±1.1	16±1.1
Slovenia ^c	7.5±1.8	5	1	Pear-shaped	7.1±0.8	11±1.0	17±1.3
France (vosges) ^c	11.2 ±1.6	5	1	Pear-shaped	6.2±0.7	11±1.3	16±1.5
France (jura) ^c	10.9±2.3	6	1	Pear-shaped	6.2±0.6	11±1.1	16±1.6
France (alps) ^c	15.1±1.2	10	0	Pear-shaped	9.0±0.8	11±1.8	18±1.6

^aMaximum number typically observed.

^bMeasurements taken on wild plants; similar figures were obtained on cultivated plants.

^cMeasurements taken on cultivated plants.

Table 1: Morphological characteristics of various population of *P. vulgaris*. Values shown with one standard deviation uncertainty when appropriate. Samplings contained five plants and or flowers except for Chenay (10 plants), Neuf-ans (19 plants) and Berru (3 plants).



E. Salvia 2007

Figure 3: Seed capsules of *P. vulgaris*: from Champagne state near Berru (left), from the Alps (right). Drawn by Elizabeth Salvia.

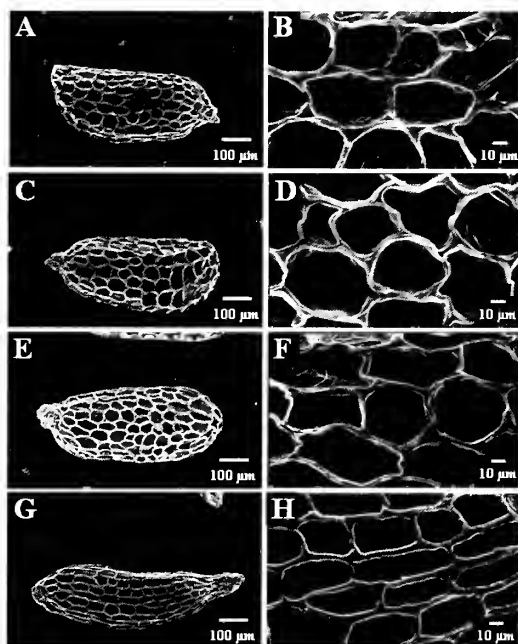


Figure 4: Scanning electron microscope view of seeds. A, B: *Pinguicula vulgaris* from Berru. C, D: *Pinguicula vulgaris* from the alps. E, F: *Pinguicula vulgaris* from Iceland. G, H: *Pinguicula mundi*. All seeds were obtained from cultivated plants. Photographs by Laurent Legendre.

while the other never gave more than 5 seeds. Despite these numbers, all of the seeds that were generated yielded viable hybrid plantlets.

All of our attempts to evaluate the number of chromosomes of the Rheims plants failed because of the small size and round nature of *P. vulgaris* chromosomes. A maximum of 30 pairs of chromosomes was counted. This value is far below the expected $2n=64$ published for other *P. vulgaris* specimens (Casper 1966).

Scanning electron microscope analysis of Rheims *P. vulgaris* seeds and pollen are respectively shown in Figure 4 and 5. Seeds were ovoid and large with reticulate seed coats. Reticulations were square to round. They were similar to those of the alpine population and differed in elongation from those of *P. nunti* seeds. Pollen grains were round and shaped like pumpkins. They had a smooth to slightly rugose surface covered by large quantities of phenolic exudates. Anthers were unilocular and opened via a single lateral dehiscence hole to allow pollen grains release.

As previously noted by Casper (1966), the structure of the hairs at the entrance of the flower throat has some taxonomic value in *Pinguicula*. In the case of the Rheims plants, all hairs were resting upon a single epidermal cell and were linear (Figure 6). They were formed by a succession of approximately three elongated cells, the length and pigmentation of which reduces by half for each successive cell with increasing distance from the epidermis, and approximately 6 to 10 white round cells, piled on top of each other like beads on a string (uniseriate). Occasionally, one of these round cells had a twin one next to it (biseriate).

A patient observation of the hundreds of *P. vulgaris* specimens present at the Paris and Lyon herbaria, coupled with past records of the French flora, allowed us to more precisely define the exact distribution of this species in France. Most sites had been herborized very regularly in the 18th and 19th century. Then, *P. vulgaris* vanished at many sites during the first half of the 20th century (Figure 7). The Rheims populations all grow on the Champagne plateau, and are on the edge of what was once a large *P. vulgaris* population that covered the Paris valley. Most of the phenotypic diversity observed on herbarium specimens was found in the now-extinct Paris populations (very sad news indeed) and will be described in a separate article.

All three Champagne populations grew in alkaline bogs. These are characterised by massive growth of a vegetation (mostly grasses) that is surprisingly luxuriant for a temperate zone. Accumulation of dead plant debris is faster than its degradation so that peat matter accumulates. Since *Sphagnum* does not occur at such sites, the peat in alkaline bogs is different from the one found in acidic peat bogs (where *Drosera* grows in the northern hemisphere for example). Its mineralisation is also different since acidic peat bogs have soft waters and alkaline bogs hard waters. In the horticultural trades, acidic peat is often sold under the name blond or sphagnum peat while alkaline bogs peat is sold under the name black peat.

The smallest of the three Champagne populations (at Chenay) occurred in a very wet alkaline bog. Grasses were tall and grew in patches that formed little islands above shallow standing water. Plants developed with their roots in the water, growing through the dead and submerged leaves of grasses that were coated with hard mineral deposits. At the other two sites (Neuf Ans and Berru), the plants grew at the edge of a spring (in a horse field and on a trail grazed by horses respectively). The plants at Berru were living on a soil layer dating from the inferior Ypresian ("Sparnacian") from the tertiary period. The plants at Neuf Ans were growing on material dating from the middle Thanetian (tertiary period) that had spilled over an earlier geological formation (white chalk) from Senonian of the secondary period. This site was emerging from under a sandy soil layer of the superior Thanetian. Thus, in both cases, plants were found at a place where several soil ingredients (sand, clay and tuff or chalk) were mixed. The pH of all three sites near the plants was around 6.5. In this transitional ecotone between forested habitat on the sandy soil, and tall grass in the wetter part of the alkaline bog, competing vegetation was scarce. Water springs appeared at these spots after water had percolated through the forest soil and drained on the clay layer beneath it. It then accumulated to form a wetland (alkaline bog) lower down as depicted in Figure 8.

Most, if not all, insect captures were made at night or very early morning in all three

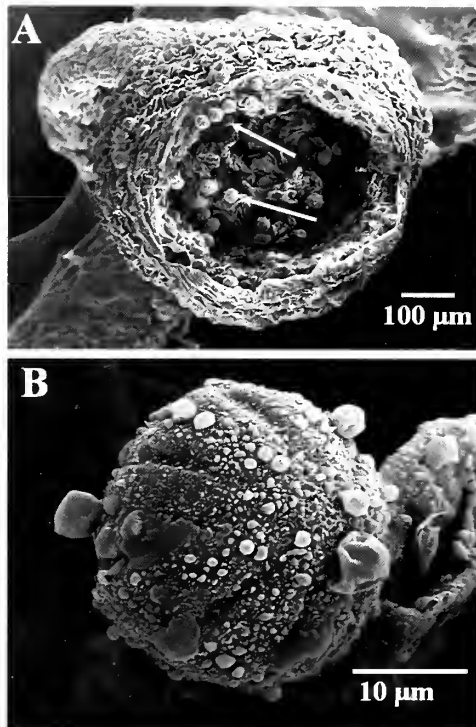


Figure 5: Scanning electron microscope view of anther and pollen. A: *Pinguicula vulgaris* anther for a plant from Chenay. Arrows indicate individual pollen grains. B: *Pinguicula vulgaris* pollen grain for a plant from Chenay. The bag-like structures on the pollen grains are phenolic secretions that have not been washed off during sample preparation. Photographs by Laurent Legendre.

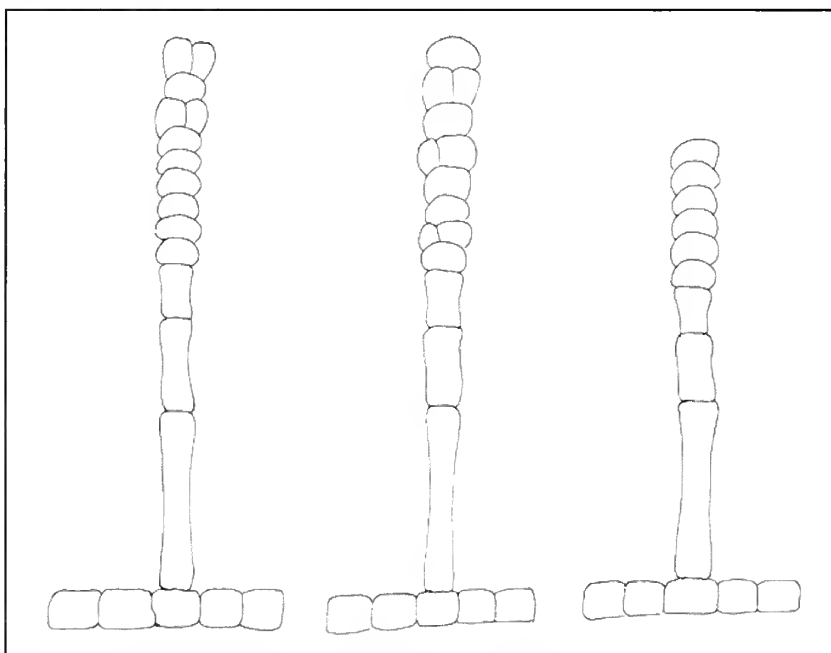


Figure 6: Three examples of flower throat hairs of *P. vulgaris* from Berru. Drawn by Laurent Legendre.

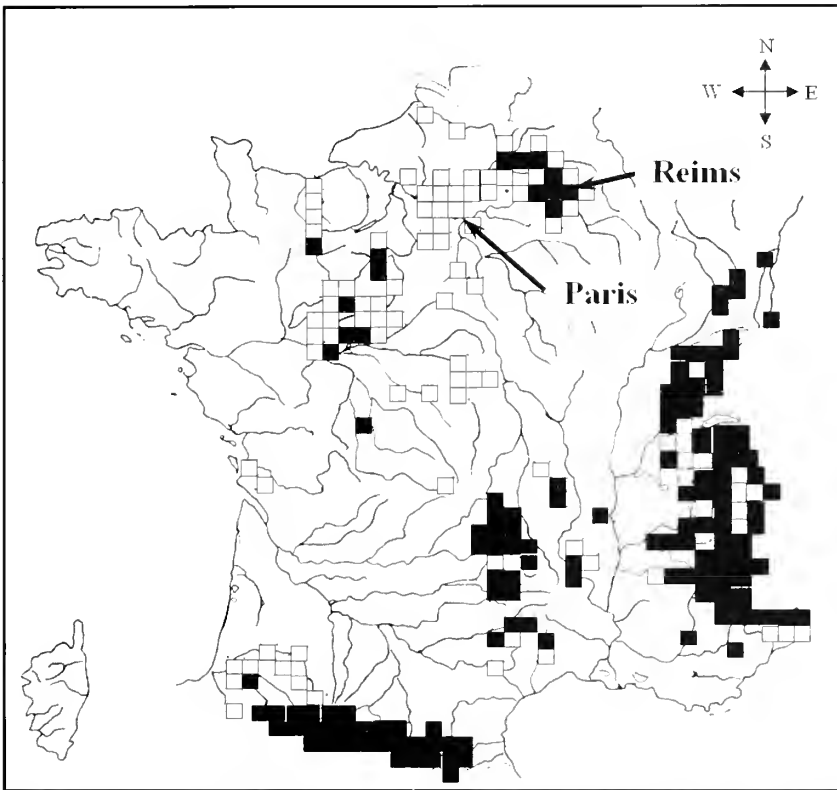


Figure 7: Geographic distribution of *P. vulgaris* in France before 1960 (black and white squares) and after 1960 (black squares only). Map prepared by Laurent Legendre according to Dupont, 1990.

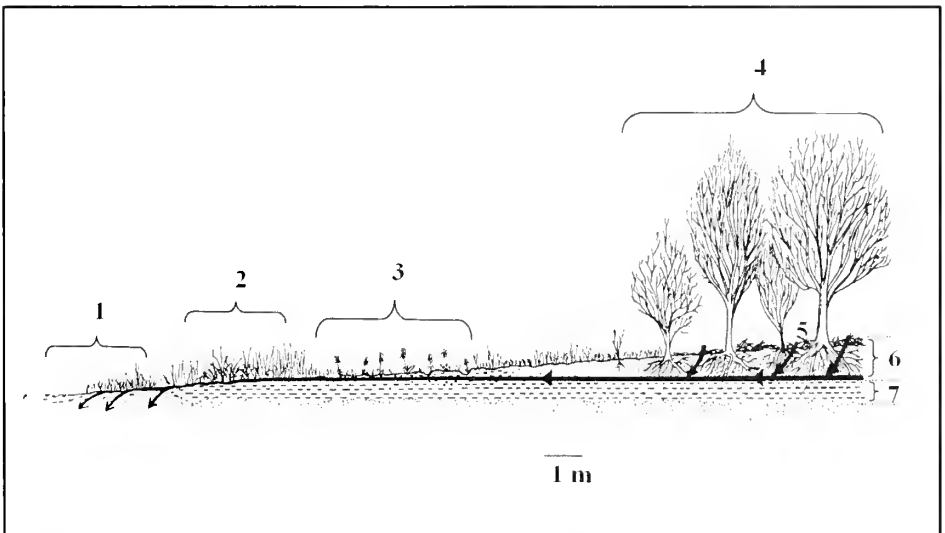


Figure 8: Biotic and abiotic conditions found in all *P. vulgaris* sites of this study. Local geological formations are made of alternate layers of sand (6) and clay (7) which are both calcareous. Rainwater in the forest (4) drains through the sandy soil (5) to collect on the clay layer and create a wetland (2) lower down the hill. The wetland drains in a lower sandy layer (1) and *Pinguicula* plants are found where the water first emerges and the sand and clay layers mingle (3). Drawn by Thomas Cieslack.

Champagne populations. Plant rosettes were the largest in very shaded spots but these plants produced the fewest (if any) flowers. Few insects could be seen on their leaves. Plants found in sunny spots were very small and generally generated only one flower per season. Their leaves were dry and free of sticky mucilage. Plants in intermediate areas (receiving no direct sun but lots of light) did best in terms of insect captures and flower production (often two per plant). Their rosette size was also close to that of the largest specimens.

The three populations decreased in size significantly during the years of this study (Table 2). At the Berru site, this could be attributed at least in part to the fact that outflow from a small artificial lake 3 km upstream had been diverted in late 1994, thus leading to a reduction in the quantity of water coming out of the spring where the plants were growing. Otherwise there was no obvious explanation (such as direct destruction of habitat) for the population decreases observed.

<i>Pinguicula vulgaris</i> population estimates						
	1994	1995	1996	1997	1998	1999
Chenay	200	150	50	20	10	10
Neuf-ans	10,000	10,000	8,000	6,000	4,000	2,000
Berru	2,000	1,500	500	200	100	100

Table 2: Number of plants growing on each of the three Champagne *P. vulgaris* populations from 1994 to 1999.

Discussion

The flowers of the *P. vulgaris* populations growing near the city of Rheims were similar in size and shape to those of other *P. vulgaris* populations. Pollen, seed, calyx and flower throat hair shapes and sizes were also similar to descriptions of other *P. vulgaris* specimens (Casper 1966; Steiger 1998). Differences were evident in the shape of the seed capsule, the rosette diameter, the number of flowers per season and the number of vegetative reproductive buds in the winter. Even though tedious, a study of all *P. vulgaris* populations worldwide would be necessary to appreciate the importance of such phenotypic variations in the natural variability of this genus.

Of all of the characters under study, the size of the rosette was the most variable one, with values ranging from 3.9 to 16.8 cm in diameter. Even though the Rheims plants were found to be the smallest of the group, it is difficult to draw any conclusion from this parameter because rosette size proved dependent upon the growing conditions (humidity, fertilization) unlike the size of the corolla and calyx. Moreover, the Rheims plants were not significantly different in size to some of the populations under study (i.e. those in Iceland and Slovenia).

Temperate *Pinguicula* in section *Pinguicula* (c.a. 15 species—see Casper 1966; Legendre 2000 for a sub-classification of the genus) differ from other species by their ability to generate a large number of vegetative reproductive buds from their winter hibernacula. *Pinguicula vulgaris* is an exception in this group (as confirmed by our measurements) because it typically produces very few vegetative buds. In this trait, the Rheims populations resemble the other species of section *Pinguicula*, such as *P. grandiflora* for example. By the same token, the globose shape of the seed capsule of the Champagne plants differs from the pear-shaped seed capsules of other *P. vulgaris* plants (this feature is also noted in Steiger 1970, 1973) and some members of section *Pinguicula* such as *P. grandiflora*. Globose seed capsules are produced by other members of this sub-section such as *P. bohemica* and *P. leptoceras* and by most other *Pinguicula* species (Casper 1966; Steiger 1970, 1973).

By generating more vegetative buds and less seeds (less flowers per plant per season), the Rheims plants differ in reproductive habit from the other *P. vulgaris* specimens under study. It is difficult to see whether this difference is linked to some local selection pressure element or is a mutation without evolutionary value. Nevertheless, it has the potential to affect the ratio of vegetative vs. sexual reproduction in these plants and therefore the flow of genetic information through their populations. Gemmae could participate in plant dispersion in the Champagne state since we have observed them in mud clods attached to the feet of horses crossing these populations.

The differences of timing in the growing phases that we observed on the Rheims plants are puzzling. These differences were significant and reproducible when comparative cultivation experiments

were conducted in Rheims, but could not be seen when these same experiments were conducted just 200 km westward in a western suburb of Paris—this discrepancy may be due to differences in local weather conditions. Rheims is located on top of the Champagne plateau (86 m above sea level) and is subject to a continental climate with large and unpredictable temperature fluctuations, unlike the climate of Paris, which is buffered by the Atlantic Ocean and the human activity in its midst. The peculiar growing cycle of the Rheims plants, if real, may result in a competitive advantage by increasing annual growth, as was observed in *P. longifolia* subsp. *longifolia* (García *et al.* 1994).

Pinguicula vulgaris was very common in the Champagne state more than 100 years ago. The drainage of the many wetlands has lead most populations to disappear. Within the remaining wetlands, it is hypothesized that *P. vulgaris* has disappeared, or is losing members, because of a lack of grazing (traditionally conducted by Polish horses) and the consequent overgrowth of grasses (very tall in these alkaline bogs). It is not clear why populations are diminishing in higher, more solid ground. The populations are blooming, do not show diseased plants, and their direct habitat is not undergoing any obvious land-use changes. We hypothesize that their disappearance is linked to macro-climatic changes that lead gradually to a lowering of the air humidity. High humidity and light were found to be required for optimum plant growth, blooming and insect capture in habitat. This part of France was renowned for its frequent foggy days and large wetlands (recorded in World War I and during the Napoleonic era). Now that the wetlands are dry for the most part (after peat extraction and water drainage) and that most of the forest has been cut down, one can observe a loss of air moisture, an increase in ground-level wind velocity that both lead to fewer foggy days (15 from the start of April to the end of August 1997). If such hypotheses are correct, it will be difficult to revert the course of extinction of these plants.

In a misguided effort to protect these plants, local carnivorous plant enthusiasts cut down most of the tree branches and removed grass at the Berru site in 2000. This led to a near-complete extinction of this population (down to less than 5 individuals a year later) and increased sun and wind exposure. The *Pinguicula* population has since grown back as the habitat recovered. Such measures have, nevertheless, benefited the native sundews (*Drosera anglica*). We suggest that the best results for *Pinguicula* protection will be achieved if the correct balance is reached between enough neighboring plant growth to raise the humidity and not too much overgrowth to let the plants access enough light. Diverting more water to their sites would also help along with regular grass cutting (like grazing by horses). When the populations of *Pinguicula* in Champagne state were larger, they were more resilient to minor changes in local abiotic conditions. Now, the few populations are in a much more precarious state.

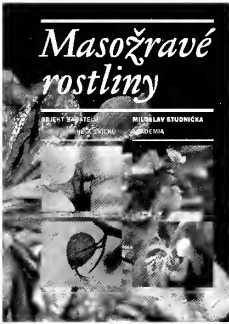
Acknowledgements

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BOOK REVIEW



Studnička, Miloslav. 2006. *Masožravé rostliny - objekt badatelů, dobrodruhů a snů* (Carnivorous Plants—Objects of Investigators, Adventurers and Dreamers, in Czech). Academia, Praha 331 pp., 413 colour photographs. ISBN 80-200-1404-7, 395 CZK (approximately 19 USD or 14 EUR).

Reviewed by Jan Schlauer

Yet another Czech carnivorous plant book! Yes, this one does (once again) have many illustrations but it is the text that makes it really noteworthy. Thus, I really hope an English translation will become available to reach the audience it deserves.

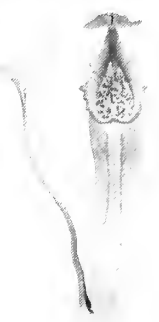
The author (not at all unknown to readers of this journal) manages almost on each page to reveal some unexpected aspect of carnivorous plants that surprises even the experienced grower or researcher. Of course there are not many colleagues who could claim a comparable chain of experience gained throughout an inspiring (yet at times challenging) life, but even among those who could there would remain only very few who could coin it into such elaborate and entertaining narrative.

This second book by Miloslav Studnička under the same title, (the first one appeared in 1984—almost one generation and a whole world ago), does make a difference. After some introductory notes (16 pages) the main part (277 pages) is devoted to descriptions of families, genera and species of carnivorous plants, focusing on those regularly seen in collections and including horticultural as well as all kinds of scientific and sometimes “polemic” notes. Concluding chapters (11 pages) include “Life in traps” (describing animals living in animal trapping plants), plants trapping insects by their flowers without devouring them (mainly featuring *Aristolochia*, *Ceropegia*, and *Coryanthes*, but also mentioning aroids), carnivorous plants in the botanical system (based on “classical” theories which are, however, untenable in the light of more recent work and not quite as verified as the author surmises), and important moments of carnivorous plant research.

There are certainly some debatable aspects about this book (most species chosen for detailed descriptions have been covered by previous publications, the photographs of some rather microscopic taxa should have been taken from a shorter distance or through another lens, some theories are—intentionally—speculative) but it is impressive to see the author’s vast experience combined with a strong independent and endlessly curious mind. Most of the crucial experiments mentioned in the book that illustrate how carnivorous plants work, have actually been performed by the author himself. Their explanatory value is in many cases far higher than work that has consumed much more manpower, resources and sophisticated equipment. Not only carnivorous plant literature but also contemporary life science in general would greatly benefit from more personalities of this style.

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LITERATURE REVIEWS

By Doug Darnowski, Barry Rice, Jan Schlauer.

Adam, J.H. and Hafiza, A.H. 2007. Pitcher Plants (*Nepenthes*) Recorded From Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia, International Journal of Botany 3(1): 71-77.

Nepenthes sharifah-hapsahii from peninsular Malaysia, is described as new to science. The plant is intermediate in most features between *N. mirabilis* and *N. gracilis*. If it is a hybrid between the two species, the present paper constitutes the first valid publication of a name for it. In an earlier paper co-authored by the first author (in J. Trop. Forest Sci.5:22, 1992), this hybrid (then from Borneo) was called *N. ghazallyana*, but it was not described formally. (JS)

Anderson, B., and Midgley, J.J. 2007. Density-dependent outcomes in a digestive mutualism between carnivorous *Roridula* plants and their associated hemipterans. Oecologia. 152: 115-120.

The authors have been publishing on plants in the genus *Roridula* for several years, developing a case in which they argue that *Roridula* should be considered carnivorous. While these plants do not produce their own enzymes, they effect digestion through a mutualist relationship with hemipteran insects (*Pameridea* sp.) that live upon the plants. Furthermore, the authors have argued in the past that cuticular gaps in the leaves are specialized adaptations to enable the absorption of nitrogen-rich fecal matter from the *Pameridea*, thus completing the digestive pathway. In the current paper, the authors manipulated the population levels of *Pameridea* on *Roridula dentata*. When the populations were very low, *Roridula* grew poorly because it was starved of nutrients; similarly when the populations of *Pameridea* were very high *Roridula* also grew poorly, apparently because *Pameridea* feeds directly upon *Roridula* sap when no other food is available. An optimal, intermediate population level of *Pameridea* was noted. It is possible that the specialist spider (*Synaema marlothi*) that also lives on *Roridula* may prey upon captured insects but also upon *Pameridea*, and could even help control the population of the bugs and keep the population levels nearer to the optimal value. (BR)

Lee, C.C., Hernawati and Akriadi, P. 2006. Two new species of *Nepenthes* (Nepenthaceae) from north Sumatra. Blumea 51, 561-568.

Nepenthes jamban ("Jamban" is the local word for toilet) is a close relative of *N. jacquelineae*, the main difference is the narrower peristome.

Nepenthes lingulata ("with tongue") is characterized by a long linear glandular spur at the basal interior (lower) surface of the lid. Although such lid appendages are more commonly known in relatives of *N. maxima* (the Regiae of Danser) from Borneo to New Guinea, they are encountered in some species from Sumatra (e.g. *N. ovata*) as well. These species are, however, not closely related to Regiae. (JS)

Lowrie, A. and Conran, J.G. 2007. A revision of the *Drosera omissa*/*D. nitidula* complex (Droseraceae) from south-west Western Australia. Taxon 56: 533-544.

This paper addresses a number of pygmy *Drosera* taxa. First, it is revealed that *Drosera ericksoniae* is synonymous with the older name *Drosera omissa*, which therefore has precedence. Next, the authors consider a few taxa that they previously treated as subspecies: *Drosera nitidula* subsp. *allantostigma*, *Drosera nitidula* subsp. *leucostigma*, *Drosera nitidula* subsp. *nitidula*, and *Drosera nitidula* subsp. *omissa*. (These plants have been treated by some researchers as separate varieties instead of separate subspecies.) The authors argue these entities are best treated as separate species, and so therefore established the names *Drosera allantostigma* and *Drosera leucostigma* for the first two species. While the authors would presumably have similarly elevated *Drosera nitidula* subsp. *omissa* in rank, the name *Drosera omissa* has already been taken (as noted above), so the new name *Drosera patens* is established for it. This plant is

the missing name given as “var.?” in Jan Schlauer’s *Drosera* key (Carniv. Pl. Newslett., 1996, 25: 82.) (BR)

A notice from Jan Schlauer: In order to retain the classification used in my key the following new combination is formally made here:

Drosera nitidula var. *patens* (A.Lowrie & Conran) Schlauer comb. & stat. nov.

Basionym: *D. patens* A.Lowrie & Conran, Taxon 56: 542 (2007).

(JS)

Merbach, M.A., Zizka, G., Fiala, B., Merbach, D., Booth, W.E., and Machwitz, U. 2007. Why a carnivorous plant cooperates with an ant-selective defense against pitcher-destroying weevils in the myrmecophytic pitcher plant *Nepenthes bicalcarata* Hook. f. Ecotropica 13: 45-56.

Fans of carnivorous plants often find themselves growing other odd plants like triggerplants or ant plants. This paper shows that *Nepenthes bicalcarata* is of the latter type, like ant ferns, some species of *Acacia*, and members of the genus *Myrmecodia*, in providing shelter to ants in return for their protection. While *N. bicalcarata* can grow without an ant species to host, the ant *Camponotus schmitzi* relies absolutely on the pitcher plant for its home. This is clearly demonstrated using experiments in which the ants were removed, which led to greatly increased damage by a species of weevil, and the ants became quite agitated whenever they encountered any damage to the plants. Finally, *C. schmitzi* selectively attacked these weevils when the two were placed together, leaving other insect visitors to *N. bicalcarata* in peace. (DWD)

Müller, K. and Borsch, T. 2005. Phylogenetics of *Utricularia* (Lentibulariaceae) and molecular evolution of the *trnK* intron in a lineage with high substitutional rates. Plant Syst. Evol. 250: 39-67.

Molecular methods are used to investigate the relationships within the genus *Utricularia*. For the most part, the authors conclude that the sections used by Taylor (1989) are supported; for example the reduction of the genus *Polypompholyx* to a section of *Utricularia* is reaffirmed. However, noteworthy new conclusions include the following. (1) The authors conclude that the genus *Utricularia* should be divided into three subgenera (i.e. *Polypompholyx*, *Utricularia*, and *Bivalvaria*), and not just two as used by Taylor. This is in part achieved by moving section *Pleiochasia*, which includes familiar species such as *U. dichotoma* and *U. uniflora*, into subgenus *Polypompholyx*. An implication of this perspective is that the Australian species are of an ancestral status, which is difficult to explain. (2) Section *Iperna* is merged into section *Orchidioides*, and section *Psyllosperma* is merged into section *Foliosa*. It is likely that this paper will stimulate a great deal of discussion and argument—the relationship trees that result from molecular studies can be interpreted different ways, and different authors will do just that. (BR)

Nerz, J. and Wistuba, A. 2007. *Nepenthes mantalingajanensis* (Nepenthaceae), eine bemerkenswerte neue Spezies aus Palawan (Philippinen). Taubblatt 59: 17-25. (in German)

This plant (named as a compensation to colleagues who have criticized the epithet “flava” as too simple for such an extraordinary plant) is similar to *N. mira* and *N. deaniana*, both (if at all distinct) likewise from Palawan. The safest distinguishing feature (if one is not able to distinguish ovate from obconic pitchers without actually seeing them side by side—the type specimen of *N. deaniana* is presumed lost, and the taxon can most accurately be described as poorly known) is apparently in the inflorescence that has exclusively single, unbranched pedicels. In the other species at least the lower part of the inflorescence there are some two-flowered partial peduncles. (JS)

Plachno, B.J., Koziardzka-Kiskurno, M., and Swiatek, P. 2007. Functional ultrastructure of *Genlisea* (Lentibulariaceae) digestive hairs. Annals of Botany 100: 195-203.

The authors provide an excellent improvement in our understanding of the fine structure of the hairs of *Genlisea*, one of the least well understood carnivorous plants. Besides very high quality scanning and transmission electron micrographs, including very nice freeze fracture work, the authors demonstrate that the placement of the digestive hairs shows *Genlisea* to be a primitive genus in the Lentibulariaceae, with some variation in structure between the two sections of the genus *Genlisea* (*Tayloria*, *Genlisea*). The structure of the cell walls and cuticle is particularly important, and the authors demonstrate the presence of cuticular pores involved in absorptive processes. (DWD)

Wistuba, A., Nerz, J. and Fleischmann, A. 2007. *Nepenthes flava*, a New Species of Nepenthaceae from the Northern Part of Sumatra. Blumea 52 (1): 159-163.

Yet another close relative of *N. jacquelineae*, this time distinguished by a narrower peristome (cf. *N. jamban*) and a glandular crest at the base (cf. *N. ovata* & *N. lingulata*). Moreover, the yellow ("flava" means yellow) colouration of the upper pitchers is stated to be characteristic. (JS)

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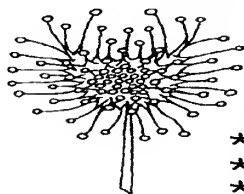
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NEW CULTIVARS

Keywords: cultivar: *Utricularia alpina* 'Pittier Moon'.

Utricularia alpina 'Pittier Moon'

Submitted: 17 January 2007

Gert Hoogenstrijd and I grow a large number of species from the *Utricularia* section *Orchidioides*, which are referred to collectively as the "epiphytic" species. One of the plants we grow is a clone of *Utricularia alpina* of uncertain provenance (but which is purported to have originally come from Henry Pittier National Park). We have grown and distributed this clone for a few years under the informal name "Henry Pittier clone #1" and we feel that its excellent attributes and unique nature merit cultivar status.

After a brief discussion, on Dec. 12th 2006 my co-author and I chose to give this plant the cultivar name *Utricularia* 'Pittier Moon'. Since this plant has previously been distributed as "Henry Pittier clone #1" we felt it was important to keep the name familiar to those who already have this plant so we have chosen to retain the "Pittier" epithet of the name. The large, white showiness of the blooms evokes thoughts of the full moon, hence the second, descriptive portion of our name.

This plant is significantly more robust when compared to the more typical forms of *U. alpina* found in cultivation (see Figure 1) and has occasionally been referred to by horticulturists as a "giant" or "large" form. The leaves are large—typically 20-45 cm long and 4-8 cm wide. This is 2-6 times the size of typical clones in cultivation, which for us are 8-20 cm long and 1.5-4 cm wide. They are also quite thick and almost succulent in texture. In outline they are diamond-shaped with a distinct petiole. Likewise, the blooms of this plant are 1.5-2.5 times larger than those of typical clones (see Figure 2) Flowers are typically born 2-4 on an inflorescence and, other than their large size, are typical for the species.

While this plant does produce viable seed from self-pollinated blooms it is not currently known whether the plants attained from these seed will display the same robust characters and as such only plants propagated by vegetative means should retain the cultivar name. Therefore, seed produced by this plant should be labeled and distributed as nothing more than *U. alpina*.

Utricularia 'Pittier Moon' is not the only large form of *U. alpina* in cultivation, for example there is a plant in cultivation frequently labeled "Henry Pittier clone #2"; this is a different plant that has extremely long inflorescences and small flowers. While noteworthy, this and other large clones of *U. alpina* do not necessarily have the same character details.

—TRAVIS H. WYMAN AND GERT HOOGENSTRIJD • 4063 Indian Lakes Circle • Stone Mountain GA 30083 • USA • asplundii@gmail.com



Figure 1: Foliage of normal clone of *U. alpina* from Atlanta Botanical Garden (left) compared to *U. alpina* 'Pittier Moon' (right). Photograph by Travis H. Wyman.



Figure 2: Flower of normal clone of *U. alpina* from Atlanta Botanical Garden (left) compared to *U. alpina* 'Pittier Moon' (right). Photograph by Travis H. Wyman.

BOOK REVIEW

Pásek, Kamil. 2006. Masožravé rostliny (carnivorous plants, in Czech). Grada publishing, a.s., Praha, Czech Republic. ISBN 80-247-1249-0, 96 p., 100 colour photographs, numerous line drawings (mainly illustrating details or distinguishing features). Soft cover, A5 (15 × 21 cm), CZK 98; SKK 149, overseas pricing and shipping conditions on demand, contact the publisher obchod@gradapublishing.cz. <http://www.grada.cz/katalog/kniha/masozrave-rostliny/>.

Reviewed by Jan Schlauer

This book is primarily intended for (Czech reading) growers who want to get started quickly with a compact set of instructions for successful cultivation. The photographs are well done and contain some shots of not too frequently seen species.

This publication is a useful introduction to carnivorous plants and primarily to their cultivation. For further reading some references or book recommendations would be helpful (not included in the book). These may, however, be retrieved from the cited website, and there is a contact address and phone number cited in the book for those who do not have easy internet access.

7th Conference of the ICPS in 2008!

It gives me great pleasure to announce that the 2008 International Carnivorous Plant Society Conference will be held in Sydney, Australia. The venue chosen is the Royal Botanic Gardens, in the heart of the city, close to many facilities. Since this is the first time this biennial conference has been held in the Southern Hemisphere it was deemed appropriate for it to be held at a time when the carnivorous plants across most of southern Australia would be at their best, and so the conference will be held from the 25nd to the 28th of September. The conference will include a number of lectures and demonstrations, and there will be some optional field trips to the Blue Mountains and Mt Tomah Botanic Gardens, both within 3 hours drive from Sydney. Provisions are also being made for a field trip to see *Cephalotus*, pygmy sundews and tuberous sundews in South Western Australia for conference attendees able to make it to this part of the country during their stay down under. Stay tuned for further details, and please mark the dates in your diaries; we'd love to see you in Sydney in 2008.

Greg Bourke

LOOKING BACK: CPN 25 YEARS AGO

Rich Sivertsen wrote on a *Sarracenia alata* site slated for destruction in Texas, no doubt now long gone: "(The landowner) plans to bulldoze the pasture and reseed it to grass this winter and has given an open offer to anyone interested in CP to come and collect all the *S. alata* they want.... It is felt that a six-pack would be an appropriate gratuity."

Have you ever noticed that those who have only been growing plants for a few years feel they know all the answers, while those who have a long history of growing rarely give prescriptions for sure success? In a great article starting on page 96, Don Schnell reminded us about why plants sometimes simply do not grow. Give this piece a read!

DVD REVIEW

Miller, Jim & McPherson, Stewart. 2007. *Lost Worlds*. 2-DVD set, 50/45 minutes running time. Redfern Natural History Productions Limited, UK. Approximately US\$28 + \$10 shipping.

Reviewed by Stephen Davis

For those of you that read "Pitcher Plants of the Americas" by Stewart McPherson, and finished feeling like you had to see more, there is hope. "Lost Worlds," a DVD narrated by McPherson himself, shows the best of the images from several intrepid explorers that didn't make the book. It is an 80 minute slideshow, plus some video, of the Guiana Highlands, home of the Tepuis, some of the most rugged and spectacular places on this planet. *Heliamphora*, and other carnivorous plants.

The images are spectacular, and the music, performed by The Slovak National Symphony Orchestra for this DVD, adds to the experience. Jim Miller scanned through over 14,000 images, then "animated" them so the slideshow is not a static series of fades. The result is a pleasing and smooth presentation.

Unlike the photographs in the book which usually show close views of plants, a large number of the images are of the tepuis and surrounding area. It gives you a better concept of the cloud forest environment in which the plants evolved and now grow in. It offers many surprises as dazzling images of carnivorous plants, including *Heliamphora*, *Drosera*, *Brocchinia* and *Catopsis*, as well as orchids, non-carnivorous bromeliads and other plants are shown growing on sheer rock faces, tree limbs and other seemingly inhospitable places. Although I "knew" they grew like this, seeing it speaks volumes.

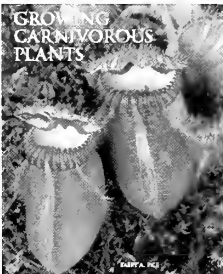
The first DVD is a fully narrated 34 minute show of the tepuis, their history, flora and fauna with many images of our precious carnivorous plants. McPherson does a great job of narrating, keeping it informative and interesting. There is also a 7 minute video, "*Venezuela's Lost Worlds—Roraima and the Guiana Highlands*."

The Bonus DVD is about 45 minutes of additional images organized by topic, including each species of carnivorous plant, plus orchids, the ranges themselves, and other flora.

The above list of contents is what the buyer can expect—information on the promotional web site for the DVD set is inaccurate as to the exact contents of the DVDs.

Between the two DVDs, twelve of the fifteen species of *Heliamphora* described in McPherson's book are shown in stunning detail, although not always identified. The recently rediscovered *Drosera meristocaulis* is also shown.

I wish the menus on the Bonus DVD were set up so you could go directly to a section. Also, there is a shimmering of some of the photos I found distracting. Both Barry Rice and I had trouble running our DVDs on older equipment, but I was able to play it on newer equipment without a hitch. Miller felt we probably got some bad disks and that has not been the experience of others that have the DVDs. Overall, this is a beautiful addition to the collector's carnivorous plant library.



Growing Carnivorous Plants (the book)

Yes, you can get copies from the publisher or Amazon.com, but buy your copy directly from the author, Barry Rice, and he will sign it for you! Very cool, indeed!

Instructions at <http://www.sarracenia.com/cp.html>, or send a check (payable to "Barry Rice" in US\$) to: P.O. Box 72741, Davis CA 95617, USA. Total cost: US\$47.95 within the USA. International customers—refer to the web site.

A GENLISEA MYTH IS CONFIRMED

FERNANDO RIVADAVIA • Rua Inacio Pedroso 230 • 05612-000 • São Paulo, S.P. • Brazil • fe_riva@uol.com.br

Keywords: cultivation: Observations: *Genlisea pygmaea*, Brazil—physiology: *Genlisea pygmaea*.

The genus *Genlisea* comprises approximately 20 known species, divided more or less equally between Africa and the New World tropics and subtropics. The unique inverted “Y”-shaped corkscrew traps of *Genlisea* species as well as the five calyx lobes (versus two or rarely four) allow one to easily differentiate any species in this genus from species belonging to the closely related genus *Utricularia*, also a member of the Lentibulariaceae family.

All species of *Genlisea* produce basal rosettes of light to dark-green leaves, which are usually a few millimeters to a few centimeters in length, and which vary from spatulate to filiform in shape. The exceptions include *G. angolensis* R.D. Good, *G. guianensis* N.E. Brown, and *G. sanariapoana* Steyermark which have elongated strap-shaped leaves. Furthermore, the leaves of the latter two species are often deep red in color and may reach 20 cm in length.

Genlisea aurea A. Saint-Hilaire has one of the most unique leaf rosettes in the genus, consisting of dozens, maybe hundreds, of narrow leaves covered in clear gelatinous mucilage. On the other hand *G. uncinata* Fromm-Trinta often has only 1-3 leaves per plant and most of the photosynthesis appears to be carried out by the long-lasting inflorescences.

The inflorescences of *Genlisea* vary widely in size, from hair-thin single-flowered scapes a few millimeters in height in *G. filiformis* A. Saint-Hilaire to thick succulent scapes over 1.2m in length in *G. uncinata*. Flowers vary in color between yellow, cream, white, lilac, purple, and pink, but do not vary too much in size (Fromm-Trinta 1979; Taylor 1991). The taxonomy of *Genlisea* is heavily based on inflorescence pubescence: presence or absence of hairs, whether these are glandular or simple, as well as their density and distribution.

The genus *Genlisea* is divided into two sections, *Genlisea* and *Tayloria*, based on the way their fruits open when mature. Section *Tayloria* represents only three species from Brazil (*G. uncinata*, *G. violacea* A. Saint-Hilaire, and *G. lobata* Fromm-Trinta), with fruits that dehisce into two longitudinal valves. Section *Genlisea* includes all other species in the genus with unique fruits that are circumscissile, splitting in a circumference halfway up from the base as well as along two circles (akin to latitude lines on a globe) further towards the apex (Taylor 1991).

Although only *G. repens* Benj. is reported to form elongated underground stolons—like many *Utricularia* species—most species of *Genlisea* do in fact form a very short but visible stem from which arise the basal rosette of photosynthetic leaves, traps, and inflorescences (Fromm-Trinta 1979; Fischer & Porembski 2000). When these structures are removed, the stem is usually beige in color and cylindrical to obconical. The largest I have seen were on *G. aurea*, with stems up to approximately 1.5cm in length by 4mm in diameter.

Both annual and perennial species are known in the genus *Genlisea*. Annual species often occur in seasonally moist sandy soils (e.g. *G. filiformis*) and in thin layers of soil or mosses over rocks on mountainsides (e.g. *G. lobata* and *G. stapfii* A. Chev.). Perennial species often occupy permanently boggy areas (e.g. *G. hispidula* Stapf, *G. margaretae* Hutchinson, and *G. aurea*) and sometimes even semi-aquatic habitats on floating mats of dead vegetation at the edges of streams, ponds or lakes (e.g. *G. guianensis*, *G. glandulosissima* R.E. Fries, and *G. repens*) (Fischer & Porembski 2000; Fromm-Trinta 1979).

A few species of *Genlisea* (e.g. *G. pygmaea* A. Saint-Hilaire, *G. roraimensis* N.E. Brown, and *G. violacea*) do not clearly fit either category, possibly being best described as facultative (optional) annuals. These species are usually found in sandy soils that may be very wet during the rainy season, but which become barely moist to bone-dry during the dry season.

Genlisea pygmaea is a widespread and very polymorphic species. In a previous publication (Rivadavia 2000) I discussed a large form of this taxon—the only one known to me at the time.



Figure 1: A close view of the tuber attachment in *G. pygmaea*.



Figure 2: Numerous *G. pygmaea* tubers in the author's hand. A cm scale bar is shown for reference.

Since then, I have seen numerous smaller growth types in Brazil (from Minas Gerais state in the southeast to Pará state in the north to Mato Grosso state in the west) and southeastern Venezuela (Gran Sabana, Bolívar state). This species has also been reported for Colombia, Guyana, and Trinidad (Taylor 1991).

Recently, *G. pygmaea* was reported to produce two kinds of traps; short traps that spread horizontally from the stem and elongated traps that extend vertically into the soil (Studnička 1986). Because *Gentlisea* traps are so fragile and often break when collected, dimorphic traps are probably common among other species in the genus and have simply been overlooked. I have personally seen such dimorphism in three other species: *G. aurea*, *G. glandulosissima*, and *G. mucinata*.

I have observed *G. pygmaea* growing in habitats varying from steamy coastal plains near the equator all the way up to cool highlands at 1500m altitude. Smaller forms of *G. pygmaea* grow apparently as annuals in habitats that become heavily desiccated during the dry season. Yet larger forms of this species have always been somewhat of an ecological puzzle to me. Although their habitats also seem to dry out completely, I have found robust *G. pygmaea* specimens in flower very early in the wet season. This suggested to me that they were perennials and that somehow they were able to survive the dry season, maybe by growing in slightly wetter habitats.

I finally solved this puzzle in June 2007, during a trip to the Chapada dos Veadeiros highlands in northeastern Goiás state, in central Brazil. The dry season was picking up momentum and had already taken its toll. Only a few rare patches of the common annuals *G. filiformis*, *Drosera sessilifolia* A. Saint-Hilaire, *Utricularia laciniata* A. Saint-Hilaire & Gir., and *U. amethystina* Salzm. ex A. Saint-Hilaire & Gir. were still visible. Winter dormant *Drosera* species, such as *D. montana* A. Saint-Hilaire var. *montana* and *D. hirtella* A. Saint-Hilaire var. *hirtella* were already shutting down, while *D. cayennensis* Sagot ex Diels had already retreated completely underground and left no traces on the soil surface.

At 1470m altitude, in a sandy habitat among sparse grasses, where numerous other carnivorous plant species grew sympatrically or in neighboring habitats, I found a population of *G. pygmaea* which also seemed to be shutting down with the oncoming dry season. The leaf rosettes did not look very healthy and only flowerless inflorescences with fruit remained (the characteristic pubescence of the flower scape identified this species). The *G. pygmaea* common on the Chapada dos Veadeiros is probably the largest form of this species—also found on the Espinhaço Highlands of Minas Gerais in areas surrounding the city of Diamantina and on the Serra do Cipó.

In order to make herbarium specimens of *G. pygmaea* from this habitat and record its presence there, I began digging up a few plants. As I shook and scraped the sandy soil from around and beneath the rosettes, also removing grasses and other plants, I saw a few small white tubers (see Back Cover). At first I thought they belonged to one of the other plant species. But by the third or fourth scoop of soil, I knew it was too much of a coincidence that those tubers were always located directly beneath the *G. pygmaea* rosettes!

Although I was already certain of what I had found, I bagged a few scoops of soil with *G. pygmaea* and saved them. Two days later I was c.250km south of the Chapada dos Veadeiros, at a nice hotel in our capital, Brasília. There, I was able to sit calmly in the shower of a well-illuminated bathroom for a few hours, while I slowly and patiently cleaned *G. pygmaea* rosettes. It was extremely difficult to wash away the soil and remove bits and pieces of other plants without damaging *G. pygmaea* and breaking off the tubers. Out of about five to ten plants that were cleaned, I was only able to keep a tuber attached to the stem of a single specimen, although almost all the leaves and traps broke off.

This specimen allowed me to see how the short stem of *G. pygmaea* had suddenly made a “U” turn and grown downwards for about half a centimeter, where the tuber was formed (Figure 1). I was able to confirm this a week later while exploring near the town of Cristalina, about 150km south of Brasília. There, I found more *G. pygmaea*, this time growing in open sandy patches, without any other plants growing among them. I collected a few rosettes, and then washed them at night. Once again I was able to obtain a single clean specimen with the tuber still attached.

Although I saw up to three tubers underneath a few plants, it appears that each leaf rosette produces a single tuber. Multiple tubers probably were a result of multiple plants growing in close proximity. Each tuber measured 2-9mm in length and 2-8 in width (Figure 2). Bits of brown skin were present on the surface of some tubers, coming off very easily.

A few days after discovering the tubers I wrote to my good friend and carnivorous plant enthusiast, Marcos Cardoso, who lives Cuiabá, Mato Grosso state. A few months earlier we had visited together a population of a medium-sized form of *G. pygmaea* on the nearby Chapada dos Guimarães highlands. After seeing my pictures from the Chapada dos Veadeiros he was easily convinced to revisit this site, which he did a few days later. Although he dug up a several specimens, he saw no signs of tubers on the local *G. pygmaea*.

Thomas Carow from Germany (one of the greatest carnivorous plant cultivators and explorers) reported seeing tubers in *G. pygmaea* he collected in Brazil in the late 1980s around Diamantina, Minas Gerais (pers. comm.). I guess nobody really believed him and maybe he did not believe it himself. I know I could not believe my own eyes when I saw them! After all, no species of *Genlisea* was known to form tubers!

Tubers in *G. pygmaea* are certainly an adaptation to survive the dry season, which in Brazil south of the Amazon Basin occurs during winter, more or less from May to November. These structures were overlooked for so long because they are probably only produced early in the dry season and are attached to a live leaf rosette for a very short time, maybe 1-3 months. Thus, one would have to collect *G. pygmaea* rosettes at the right time of year in order to find the tubers attached. Several species of *Utricularia* (e.g., *U. brachiata* (R.Wight) Oliv., *U. campbelliana* Oliv., *U. geminiloba* Benj., *U. mannii* Oliv., and *U. menziesii* R.Br.) are also known to form tubers to help survive the dry season (Taylor 1989).

The confirmation that *G. pygmaea* produces tubers raises several interesting questions. The first of course is whether there are other species in the genus with this ability, but which have also been understudied and thus overlooked. A more specific question would be if all *G. pygmaea* populations produce tubers or not. And if there are truly annual forms of *G. pygmaea* that do not produce tubers, should these be separated from the perennials as a different species? And finally, such a case, should the name *G. pygmaea* be used for the tuberous or non-tuberous plants?

Acknowledgements: I would like to thank Vitor Batista for helping me with the field work carried out with *G. pygmaea* at the Chapada dos Veadeiros and at Cristalina, as well as Marcos Cardoso for studying *G. pygmaea* at the Chapada dos Guimarães in search of tubers. I would also like Barry Rice for helpful comments and suggestions. Finally, I want to thank Thomas Carow, for sharing his observations of tubers on *G. pygmaea*—and for believing what nobody else believed! No permits were required to visit or collect the plants, as described in this article. Voucher specimen of the tuberous *Genlisea pygmaea* A.Saint-Hilaire: Brasil, Goiás, Município de Alto Paraíso de Goiás, estrada A.Paraíso a Teresina de Goiás, Chapada dos Veadeiros, 23/June/2007, F.Rivadavia & V.Batista 2611 (SPF).

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NEWS AND VIEWS

Marcel van den Broek (info@carnivora.nl) writes: I would like to make a small addition to Jan Schlauer's review of Barry Rice's excellent book (Carnivorous Plant newsletter, 2007, 36:1, p21). In this review Jan states that this is the second book by Timber Press on carnivorous plants after the second edition of D. Schnell's "Carnivorous Plants of the United States and Canada". It is actually the third book by this publisher. The first one was "Carnivorous plants of the World" by J&P Pietropaolo ISBN 0881923567 in 1986. Though now a bit outdated, it was a good book for its time. Let's hope Timber Press will make it a tradition to publish a carnivorous plant books every decade.

Lee Braithwaite (tjrpact@xtra.co.nz) reported upon a web journal he saw recently: *Heliamphora* occurs in Venezuela, Guyana and Brazil and thanks to the work of people such as Wistuba and McPherson its distribution in Venezuela is becoming reasonably well known. However its distribution in Brazil and Guyana is more mysterious. It could reasonably be expected to occur on the Serra Imeri south east of Neblina, and on the chain of tepuis east of Roraima which stretch along the Guyana-Brazil border. McPherson has recently confirmed that both *H. nutans* and *H. glabra* occur on Weiassipu tepui; but whether they occur on Apokilang, Yakontipu and Maringma has been unknown.

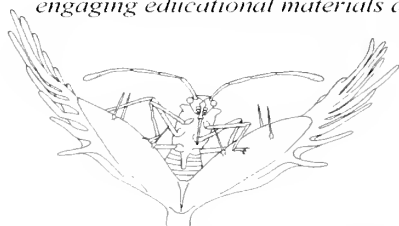
A herpetologist, Dr. D. Bruce Means has now put a journal on the web describing his travel to tepuis during 2006:

(<http://www.brucemeans.com/journal/journal/Venezuela2006.htm>).

In this he discusses Mt. Maringma where he notes that *Heliamphora nutans* occurs on its summit. As well as being the first record for this location it appears to be the easternmost record for *Heliamphora*; as there are no further tepuis to the east for a large distance this may be the furthest east that *Heliamphora* occurs.

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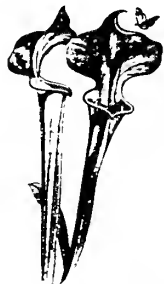
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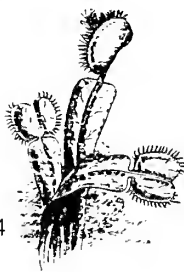
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